14

The language of chance

Syllabus reference

Probability 1

- The language of chance

The chance of an event occurring lies somewhere between impossible and certain. In this chapter we will study the mathematics of chance.

ARE YOU READY?

Try the questions below. If you have difficulty with any of them, extra help can be obtained by completing the matching SkillSHEET. Either click on the SkillSHEET icon next to the question on the *Maths Quest Preliminary Course* eBookPLUS or ask your teacher for a copy.

eBookplus
Digital doc
SkillSHEET 14.1
doc-1639
Understanding chance words

Understanding chance words

1 For each of the following events, specify whether the chance of the event occurring is certain, likely, fifty-fifty, unlikely or impossible.
- **a** A coin is tossed and it lands on Heads.
- **b** A fair die is rolled and a number less than 5 is obtained.
- **c** Two dice are rolled and a total of 1 is obtained.
- **d** Your family wins the lottery.
- **e** The maximum temperature on a summer's day in Sydney will be greater than 0°C.

eBookplus
Digital doc
SkillSHEET 14.2
doc-1640
Understanding a deck of cards

Understanding a deck of cards

2 For a standard deck of 52 playing cards, state the number of:
- **a** red cards
- **b** jacks
- **c** black queens
- **d** kings of diamonds
- **e** eights
- **f** number cards greater than 7.

eBookplus
Digital doc
SkillSHEET 14.3
doc-1641
Probability scale I

Probability scale I

3 For each of the probabilities listed below, state whether the event would be certain, likely, fifty-fifty, unlikely or impossible.
- **a** 0.2
- **b** 0.5
- **c** 0
- **d** 1
- **e** 0.9

eBookplus
Digital doc
SkillSHEET 14.4
doc-1642
Probability scale II

Probability scale II

4 List the events A, B and C below in order from least likely to occur to most likely to occur.
A – tossing a coin and having it land Heads
B – winning Lotto
C – a baby being born on either Saturday or Sunday

eBookplus
Digital doc
SkillSHEET 14.5
doc-1643
Listing the sample space

Listing the sample space

5 List the sample space (possible outcomes) for each of the following.
- **a** rolling a die
- **b** tossing a coin
- **c** spinning a circular spinner numbered from 1 to 5

14A Informal description of chance

You have booked a ski holiday to Thredbo for the middle of July. What is the chance that there will be enough snow on the ground for you to ski? There is no exact answer to this question, but by looking at the amount of snow in Thredbo during July over past years, we know that there is a very good chance that there will be enough snow to ski again this year.

We can say that it is very likely that we will be able to ski during July at Thredbo. Terms such as 'very likely', 'almost certain', 'unlikely' and 'fifty-fifty' are used in everyday language to describe the chance of an **event** occurring. For the purposes of **probability**, an event is the **outcome** of an experiment that we are interested in. We can describe an outcome as a possible result to the probability experiment.

Imagine that you are playing a board game and it is your turn to roll the die. To win the game you need to roll a number less than 7. If you roll one die, you *must* get a number less than 7. We would describe the chance of this event occurring as certain.

When an event is certain to occur, the probability of that event occurring is 1.

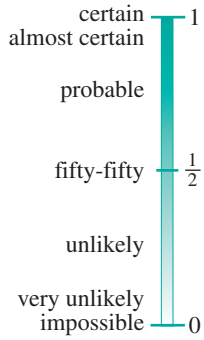
Now let's consider an impossible situation.

In a board game you have one last throw of the die. To win you must roll a 7. We know that this cannot be done. We would say that this is impossible.

When an event is impossible, the probability of the event is 0.

The chance of any event occurring will often be somewhere between being certain and impossible, and we use a variety of terms to describe where the chance lies in this range as shown in the figure at right.

We use these terms based on our general knowledge of the world, the total possible outcomes and how often an event occurs.



WORKED EXAMPLE 1

Describe the chance of each of the following events occurring.

a **Tossing a coin and it landing Heads**
b **Rolling a 6 with one die**
c **Winning the lottery**
d **Selecting a spot (numbered) card from a standard deck**

THINK	WRITE
a There is an equal chance of the coin landing Heads and Tails.	**a** The chance of tossing a head is fifty-fifty.
b There is only one chance in six of rolling a 6.	**b** It is unlikely that you will roll a 6.
c There is only a very small chance of winning the lottery.	**c** It is very unlikely that you will win the lottery.
d There are more spot cards than picture cards in a deck.	**d** It is probable that you will select a spot card.

You will need to use these terms to describe events that are more likely to occur than others.

WORKED EXAMPLE 2

Mrs Graham is expecting her baby to be born between July 20 and 26. Is it more likely that her baby will be born on a weekday or a weekend?

THINK	WRITE
There are 5 chances that the baby will be born on a weekday and 2 chances that it will be born on a weekend.	It is more likely that Mrs Graham's baby will be born on a weekday.

The term **frequency** refers to how often an event occurs. We use our knowledge about possible outcomes to order outcomes from the most frequent to the least frequent.

WORKED EXAMPLE 3

A card is chosen from a standard deck. List the following outcomes in order from least likely to most likely.

Selecting a picture card
Selecting an Ace
Selecting a diamond
Selecting a black card

THINK	WRITE
1 There are 12 picture cards in the deck.	
2 There are 4 aces in the deck.	
3 There are 13 diamonds in the deck.	
4 There are 26 black cards in the deck.	The order of events in ascending order of likelihood: Selecting an Ace Selecting a picture card Selecting a diamond Selecting a black card.

In the above examples, we have been able to calculate which event is more likely by counting the number of ways an event may occur. This is not always possible. In some cases we need to use general knowledge to describe the chance of an event occurring.

Consider the following probability problems.

'The letters of the alphabet are written on cards and one card is selected at random. Which letter has the greatest chance of being chosen, E or Q?'

Each letter has an equal chance of being chosen because there is one chance that E will be chosen and one chance that Q will be chosen.

'Stacey sticks a pin into a page of a book and she writes down the letter nearest to the pin. Which letter has the greater chance of being chosen, E or Q?'

This question is more difficult to answer because each letter does not occur with equal frequency. However, we know from our experience with the English language that Q will occur much less often than most other letters. We can therefore say that E will occur more often than Q.

This is an example of using your knowledge of the world to make predictions about which event is more likely to occur. In this way, we make predictions about everyday things such as the weather and which football team will win on the weekend.

WORKED EXAMPLE 4

During the 2006 NRL season, the Brisbane Broncos won 9 of their first 12 games. In Round 13 they played South Sydney who had won 0 of their first 12 games. Who would be more likely to win?

THINK	WRITE
Brisbane Broncos have won more games than South Sydney.	Brisbane Broncos would be more likely to win, based on their previous results. *(Footy note: South Sydney won the game 34–14. Brisbane was more likely to win the game but nothing in football is certain.)*

This is one example of past results being used to predict future happenings. There are many other such examples.

WORKED EXAMPLE 5

Weather records show that it has rained on Christmas Day 12 times in the last 80 years. Describe the chance of it raining on Christmas Day this year.

THINK	WRITE
It has rained only 12 times on the last 80 Christmas Days. This is much less than half of all Christmas Days.	It is unlikely that it will rain on Christmas Day this year.

REMEMBER

1. The chance of an event occurring ranges from being certain to impossible.
2. (a) An event that is certain has a probability of 1.
   (b) An event that is impossible has a probability of 0.
3. There are many terms that we use to describe the chance of an event occurring, such as improbable, unlikely, fifty-fifty, likely and probable.
4. Sometimes we can describe the chance of an event occurring by counting the possible outcomes, while other times we need to rely on our general knowledge to make such a description.

EXERCISE 14A

Informal description of chance

eBookplus
Digital doc
SkillSHEET 14.1
doc-1639
Understanding chance words

1 WE1 Describe the chance of each of the following events occurring, using an appropriate probability term.
- **a** Selecting a ball with a double-digit number from a bag with balls numbered 1 to 40
- **b** Selecting a female student from a class with 23 boys and 7 girls
- **c** Selecting a green marble from a barrel with 40 blue marbles and 30 red marbles
- **d** Choosing an odd number from the numbers 1 to 100

eBookplus
Digital doc
SkillSHEET 14.2
doc-1640
Understanding a deck of cards

2 For each of the events below, describe the chance of it occurring as impossible, unlikely, even chance (fifty-fifty), probable or certain.
- **a** Rolling a die and getting a negative number
- **b** Rolling a die and getting a positive number
- **c** Rolling a die and getting an even number
- **d** Selecting a card from a standard deck and getting a red card
- **e** Selecting a card from a standard deck and getting a spot (numbered) card
- **f** Selecting a card from a standard deck and getting an ace
- **g** Reaching into a moneybox and selecting a 30c piece
- **h** Selecting a blue marble from a bag containing 3 red, 3 green and 6 blue marbles

eBookplus
Digital doc
SkillSHEET 14.3
doc-1641
Probability scale I

3 Give an example of an event which has a probability that could be described as:
- **a** certain
- **b** probable
- **c** even chance
- **d** unlikely
- **e** impossible.

4 WE2 Is it more likely that a person's birthday will occur during a school term or during the school holidays?

eBookplus

Digital doc
SkillSHEET 14.4
doc-1642
Probability scale II

5 For each event on the left, state whether it is more likely, less likely or equally likely to occur than the event on the right.

a	Fine weather Christmas Day	Wet weather Christmas Day
b	A coin landing Heads	A coin landing Tails
c	Rolling a total of 3 with two dice	Rolling a total of 7 with two dice
d	Winning a raffle made up of 50 tickets	Winning a raffle made up of 200 tickets
e	Winning a prize in the Lotto draw	Not winning a prize in the Lotto draw

6 WE3 A die is thrown and the number rolled is noted. List the following events in order from least likely to most likely.
Rolling an even number
Rolling a number less than 3
Rolling a 6
Rolling a number greater than 2

7 Write the following events in order from least to most likely.
Winning a raffle with 5 tickets out of 30
Rolling a die and getting a number less than 3
Drawing a green marble from a bag containing 4 red, 5 green and 7 blue marbles
Selecting a court card (ace, king, queen, jack) from a standard deck
Tossing a coin and having it land Heads

8 WE4 Before meeting in the cricket World Cup in 2007, Australia had beaten Bangladesh in 10 of the last 11 matches. Who would be more likely to win on this occasion?

9 Which of the following two runners would be expected to win the final of the 100 m at the Olympic Games?
Carl Bailey — best time 9.92 s and won his semi-final
Ben Christie — best time 10.06 s and 3rd in his semi-final
Give an explanation for your answer.

10 MC A stack of 26 cards has the letters of the alphabet written on them. Vesna draws a card from that stack. The probability of selecting a card that has a vowel written on it could best be described as:

A unlikely
B even chance
C probable
D almost certain

11 MC Which of the following events is the most likely to occur?
A Selecting the first number drawn from a barrel containing 20 numbered marbles
B Selecting a diamond from a standard deck of cards
C Winning the lottery with one ticket out of 150 000
D Drawing the inside lane in the Olympic 100-metre final with eight runners

12 MC The ski season opens on the first weekend of June. At a particular ski resort there has been sufficient snow for skiing on that weekend on 32 of the last 40 years. Which of the following statements is true?
A It is unlikely to snow at the opening of the ski season this year.
B There is a fifty-fifty chance that it will snow at the opening of the ski season this year.
C It is probable that it will snow at the opening of the ski season this year.
D It is certain to snow at the opening of the ski season this year.

13 WE5 On a production line, light globes are tested to see how long they will last. After testing 1000 light globes, it is found that 960 will burn for more than 1500 hours. Wendy purchases a light globe. Describe the chance of the light globe burning for more than 1500 hours.

14 Of 12 000 new cars sold last year, 1500 had a major mechanical problem during the first year. Edwin purchased a new car. Describe the chance of Edwin having a major mechanical problem in the first year.

15 During an election campaign, 2000 people were asked for their voting preferences. One thousand said that they would vote for the government. If one person is chosen at random, describe the chance that they would vote for the government.

Further development

16 Give an example of an event that is:
- **a** almost but not quite certain
- **b** almost but not quite impossible.

17 Explain why it is usually sufficient to describe the probability of an event rather than assign an exact numerical value.

18 Explain why the probability of rain tomorrow cannot be exactly defined.

19 Explain why the probability of winning the lottery can be exactly defined.

20 List as many 'chance' words as you can think of.

21 Explain why probabilities range between 0 and 1.

INVESTIGATE: Common descriptions of chance

The English language has many colourful expressions to describe the chance of an event occurring. Consider the following expressions and research them to answer the questions.

1 *'That will happen once in a blue moon.'*
- **a** What is a blue moon?
- **b** How often does a blue moon occur?

2 *'There is Buckley's chance of that happening.'*
- **a** Who was Buckley?
- **b** How did this saying originate?

Are there any similar expressions that you can think of? What are their origins?

14B Sample space

At some time in our lives, most of us have tossed or will toss a coin. Many sports begin with the toss of a coin.

What is the chance that the coin will land on Heads? Most people would correctly say fifty-fifty. We need to develop a method of accurately describing the probability of an event.

Before we can calculate probability, we need to be able to list all possible outcomes in a situation. This is called listing the **sample space**. When tossing a coin, the sample space has two elements: Heads and Tails. To calculate a probability, we need to know the elements of the sample space and how many elements are in the sample space.

WORKED EXAMPLE 6

List the sample space for rolling a die.

THINK	WRITE
The sample space is the numbers 1 to 6.	S = {1, 2, 3, 4, 5, 6}

In many cases, several elements of the sample space may be the same. In such cases, we can distinguish between the number of elements in the sample space and the number of distinct (different) elements.

WORKED EXAMPLE 7

In a barrel there are 4 red marbles, 5 green marbles and 3 yellow marbles. One marble is drawn from the barrel.

a List the sample space.
b How many elements are in the sample space?
c How many distinct elements in the sample space?

THINK	WRITE
a List each marble in the barrel.	a S = {red, red, red, red, green, green, green, green, green, yellow, yellow, yellow}
b Count the number of elements in the sample space.	b The sample space has 12 elements.
c Count the number of different elements in the sample space.	c The sample space has 3 distinct elements.

In some probability elements there may be more than one element in the sample space that gives us the desired outcome. **Favourable outcomes** are the elements from the sample space that will meet the requirements for an event to occur.

WORKED EXAMPLE 8

Tegan is playing a board game. To win the game, Tegan must roll a number greater than 2 with one die.

a List the sample space.
b List the favourable outcomes.

THINK	WRITE
a List all possible outcomes for one roll of a die.	a S = {1, 2, 3, 4, 5, 6}
b List all elements of the sample space that are greater than 2.	b E = {3, 4, 5, 6}

REMEMBER

1. The sample space is the list of all possible outcomes in a probability experiment.
2. The number of elements in a sample space is the total number of possible outcomes.
3. In the sample space, there are sometimes several elements that are the same. We may be asked to count the number of distinct (different) elements in the sample space.
4. Favourable outcomes are the elements from the sample space that meet the requirements for a certain event to occur.

EXERCISE
14B Sample space

eBookplus
Digital doc
SkillSHEET 14.5
doc-1643
Listing the sample space

1 WE6 The numbers 1 to 10 are written on cards that are turned face down. The cards are shuffled and one is chosen. List the sample space.

2 For each of the following probability experiments, state the sample space.
- **a** Tossing a coin
- **b** Rolling a die
- **c** The total when rolling two dice
- **d** Choosing a letter of the alphabet
- **e** The day of the week on which a baby could be born
- **f** The month in which a person's birthday falls

3 For each of the following probability experiments, state the number of elements in the sample space.
- **a** Choosing a card from a standard deck
- **b** Selecting the winner of a 15 horse race
- **c** Selecting the first ball drawn in a Lotto draw (The balls are numbered 1–44.)
- **d** Drawing a raffle ticket from tickets numbered 1 to 1500
- **e** Selecting a number between 100 and 1000, inclusive
- **f** Drawing a ball from a bag containing 3 yellow, 4 red and 4 blue balls

4 WE7 The letters of the word MISSISSIPPI are written on cards and turned face down. A card is then selected at random.
- **a** List the sample space.
- **b** How many elements are in the sample space?
- **c** How many distinct elements in the sample space?

5 A card is to be selected from a standard deck.
- **a** How many elements does the sample space have?
- **b** How many different elements are in the sample space if we are interested in:
  - **i** the suit of the card?
  - **ii** the colour of the card?
  - **iii** the face value of the card?

6 WE8 Jane is playing a game of snakes and ladders. It is her turn to roll the die and to win she needs a number greater than 4.
- **a** List the sample space for this roll of the die.
- **b** List the favourable outcomes for this roll of the die.

7 A bag holds 60 black marbles and 40 white marbles. Tony is to choose one of these marbles from the bag. Tony wants to select a white marble.
- **a** How many elements are in the sample space?
- **b** How many favourable outcomes are contained in the sample space?

8 MC A bag contains 5 blue discs, 9 red discs and 6 yellow discs. To win a game, Jenny needs to draw a yellow disc from the bag. How many elements are in the sample space?

A 3 B 6
C 14 D 20

9 MC To win a game Jenny needs to draw a yellow disc from the bag in question **8**. How many favourable outcomes are there?

A 3 B 6
C 14 D 20

10 MC A raffle has 100 tickets. Chris buys 5 tickets in the raffle. Which of the following statements is correct?

A There are two elements in the sample space.
B There are five favourable outcomes.
C There are 100 elements in the sample space.
D Both B and C

11 New South Wales are playing Queensland in a State of Origin match.

a List the sample space for the possible outcomes of the match.
b How many elements in the sample space?
c Is each element of the sample space equally likely to occur? Explain your answer.

12 A bag contains five 20c pieces, four 10c pieces and one 5c piece. A coin is selected at random from the bag. Without replacing the first coin, a second coin is then selected.

a List the sample space for the first coin selected. How many elements does the sample space have?
b Assume that the first coin chosen was a 20c piece. List the sample space for the second coin chosen.
c Assume that the first coin chosen was a 10c piece. List the sample space for the second coin chosen.
d Assume that the first coin chosen was the 5c piece. List the sample space for the second coin chosen.

13 Write down an example of an event that has 4 elements in the sample space.

14 Write down an example of an event that has 10 elements in the sample space but only 4 distinct elements.

15 A 12-sided dice is rolled.

a How many elements are in the sample space?
b Terry is interested in whether the number rolled is a single or double digit. How many distinct elements exist for Terry's experiment?

eBookplus
Digital doc
EXCEL Spreadsheet doc-1644
Coin toss lister

16 Two coins are tossed. List the elements of the sample space.

17 Two standard dice are rolled. How many elements will be in the sample space?

18 A bag has three balls with the letters A, B and C written on them. A ball is chosen at random, the letter noted and replaced in the bag before a second ball is selected. List the sample space.

eBookplus
Digital doc
EXCEL Spreadsheet doc-1645
Dice

19 Five cards are numbered {1, 2, 3, 4, 5}. Two cards are chosen and the sum is chosen. List the sample space.

20 Explain what is meant by the terms:

a sample space
b element
c distinct element.

eBook*plus*

Digital doc
EXCEL Spreadsheet
doc-1646
Die rolling

INVESTIGATE: Matching actual and expected results

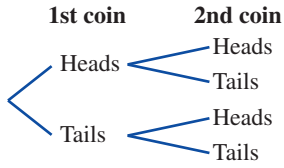
For each of the four probability experiments below, answer the following questions.

1. List the sample space.
2. How many times in 100 trials would you expect each element of the sample space to occur?
3. Conduct 100 trials of the experiment and see how closely your results match the expected results.

Experiment 1. Tossing a coin
Experiment 2. Rolling a die
Experiment 3. Selecting a card from a standard deck and noting its face value
Experiment 4. Selecting a card from a standard pack and noting its suit

14C Tree diagrams

A **multi-stage event** is where there is more than one part to the probability experiment. Tree diagrams are used to find the elements in the sample space in a multi-stage probability experiment. Consider the case of tossing two coins. How many elements are there in the sample space? We draw a tree diagram to develop a system that will list the sample space for us.



The **tree diagram** branches out once for every stage of the probability experiment. At the end of each branch, one element of the sample space is found by following the branches that lead to that point.

Therefore, when two coins are tossed, the sample space can be written:

S = {Heads-Heads, Heads-Tails, Tails-Heads, Tails-Tails}

There are four elements in the sample space; Heads-Tails and Tails-Heads are distinct elements of the sample space.

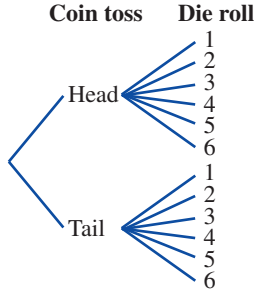
WORKED EXAMPLE 9

A coin is tossed and a die is rolled. List all elements of the sample space.

THINK

1. Draw the branches for the coin toss.
2. From each branch for the coin toss, draw the branches for the die roll.
3. List the sample space by following the path to the end of each branch.

WRITE



S = {H1, H2, H3, H4, H5, H6, T1, T2, T3, T4, T5, T6}

In many cases, the second branch of the tree diagram will be different from the first branch. This occurs in situations such as those outlined in the following worked examples, where the first event has an influence on the second event. The card chosen first can then not be chosen in the second event.

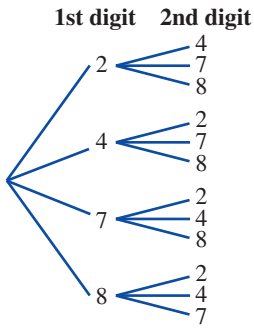
WORKED EXAMPLE 10

The numbers 2, 4, 7 and 8 are written on cards and are chosen to form a two-digit number. List the sample space.

THINK

1. Draw the first branch of the tree diagram to show each possible first digit.
2. Draw the second branch of the tree diagram to show each possible second digit. When drawing the second branch, the digit from which the tree branches can't be repeated.

WRITE

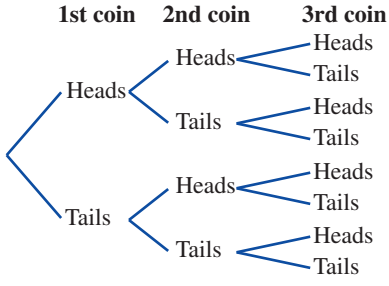


3. List the sample space by following the tree to the end of each branch.

S = {24, 27, 28, 42, 47, 48, 72, 74, 78, 82, 84, 87}

Each question must be read carefully, to see if repetition is possible or not. In the above example, the numbers cannot be repeated because we are drawing two cards without replacing the first card. In examples such as tossing two coins, it is possible for the same outcome on both coins.

When drawing a tree diagram, the tree needs to branch once for every stage of the experiment. When we roll two dice, there are two levels to the tree diagram. If we were to toss three coins, there would be three levels to the diagram, as shown at right.



WORKED EXAMPLE 11

Four children go exploring.

a Draw a tree diagram to list all possible combinations of boys and girls.

b How many elements are in the sample space?

c How many elements of the sample contain 3 boys and a girl?

eBook*plus*

Tutorial
int–2341
Worked example 11

THINK

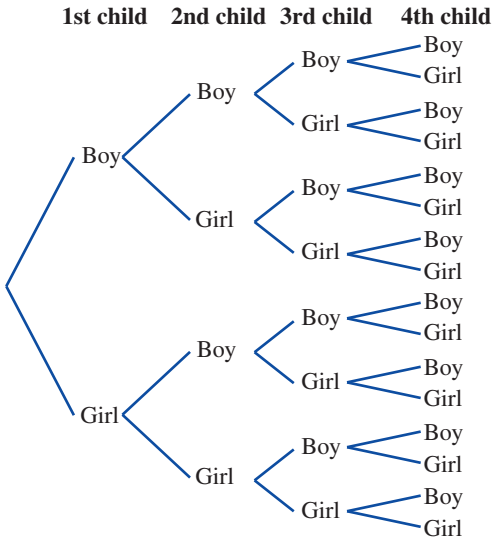
a Draw the tree diagram.

b List the sample space by following the paths to the end of each branch.

c Count the number of elements that contain 3 boys and 1 girl.

WRITE

a



b S = {BBBB, BBBG, BBGB, BBGG, BGBB, BGBG, BGGB, BGGG, GBBB, GBBG, GBGB, GBGG, GGBB, GGBG, GGGB, GGGG}

c There are four elements of the sample space which contain 3 boys and 1 girl.

REMEMBER

1. A tree diagram is necessary in any example where there is more than one stage to the probability experiment.
2. The tree diagram must branch out once for every stage of the probability experiment.
3. Once the tree is drawn, the sample space is found by following the branches to each end.

EXERCISE 14C

Tree diagrams

1 WE9 Two coins are tossed. Use a tree diagram to list the sample space.

2 On three red cards, the numbers 1, 2 and 3 are written. On three blue cards, the same numbers are written. A red card and a blue card are then chosen to form a two-digit number. Draw a tree diagram to list the sample space.

3 A family consists of 3 children. Use a tree diagram to list all possible combinations of boys and girls.

4 A coin is tossed and then a die is rolled.

a How many elements are in the sample space?

b Does it make any difference to the sample space if the die is rolled first and then the coin is tossed?

5 The five vowels are written on cards and two are selected.
- **a** In how many ways can the cards be selected if the same vowel can be used twice?
- **b** In how many ways can the cards be selected if the same vowel cannot be used twice?

6 In a game of soccer a win, draw and loss are all equally likely. In three matches of soccer how many elements does the sample space of outcomes have?

7 WE10 The digits 1, 3, 4 and 8 are written on cards. Two cards are then chosen to form a two-digit number. List the sample space.

8 Darren, Zeng, Melina, Kate and Susan are on a committee. From among themselves, they must select a chairman and a secretary. The same person cannot hold both positions. Use a tree diagram to list the sample space for the different ways the two positions can be filled.

9 A tennis team consists of six players, three males and three females. The three males are Andre, Pat and Yevgeny. The three females are Monica, Steffi and Lindsay. A male and a female must be chosen for a mixed doubles match. Use a tree diagram to list the sample space.

10 Chris, Aminta, Rohin, Levi and Kiri are on a Landcare group. Two of them are to represent the group on a field trip. Use a tree diagram to list all the different pairs that could be chosen. (*Hint:* In this example, a pairing of Chris and Aminta is the same as a pairing of Aminta and Chris.)

11 WE11 Four coins are tossed into the air.
- **a** Draw a tree diagram for this experiment.
- **b** Use your tree to list the sample space.
- **c** How many elements have an equal number of Heads and Tails?

12 MC Three coins are tossed into the air. The number of elements in the sample space is:
A 3 **B** 6 **C** 8 **D** 9

13 MC A two-digit number is formed using the digits 4, 6 and 9. If the same number can be repeated, the number of elements in the sample space is:
A 3 **B** 6 **C** 8 **D** 9

14 MC A two-digit number is formed using the digits 4, 6 and 9. If the same number cannot be used twice, the number of elements in the sample space is:
A 3 **B** 6 **C** 8 **D** 9

15 A two-digit number is to be formed using the digits 2, 5, 7 and 8.
- **a** If the same number can be used twice, list the sample space.
- **b** If the same number cannot be repeated, list the sample space.

16 The numbers 1, 2, 5 and 8 are written on cards and placed face down.
- **a** If two cards are chosen and used to form a two-digit number, how many elements are in the sample space?
- **b** If three cards are chosen and used to form a three-digit number, how many elements are in the sample space?
- **c** How many four-digit numbers can be formed using these digits?

Further development

17 A school captain and vice-captain need to be elected. There are five candidates. The three female candidates are Tracey, Jenny and Svetlana and the male candidates are Richard and Mushtaq.
- **a** Draw a tree diagram to find all possible combinations of captain and vice-captain.
- **b** How many elements are in the sample space?
- **c** If boys are filling both positions, how many elements are there?
- **d** If girls are filling both positions, how many elements are there?
- **e** If students of the opposite sex fill the positions, how many elements are there?

18 When two coins are tossed there are three elements in the sample space, 2 Heads, 2 Tails or 1 Head and 1 Tail. Is this statement correct? Explain why or why not.

19 Two dice are rolled.

a Use a tree diagram to calculate the number of elements in the sample space.

b Steve is interested in the number of elements for each total. Copy and complete the table below.

Total	2	3	4	5	6	7	8	9	10	11	12
No. of elements											

c How many elements of the sample space have a double number?

20 Vanessa is doing a multiple choice exam. Each question has four options A, B, C and D. Vanessa knows all but three answers and decides to guess each.

a How many elements will the sample space for the three guesses have?

b If Vanessa decides not to guess the same letter more than once, how many elements will the sample space have?

21 Theresa is drawing a tree diagram to represent the roll of two standard dice. She does not need to know the number rolled, only if a six is rolled or not rolled.

a Draw the tree diagram to show the outcomes to Theresa's experiment.

b Explain if each outcome in the sample space is equally likely.

22 The numbers 1, 2, 3 and 4 are written on cards.

a If two cards are chosen at random and repetition is not allowed, how many fewer ways can they be selected?

b If three cards are chosen at random and repetition is not allowed, how many fewer ways can they be selected?

eBookplus
Digital doc
WorkSHEET 14.1
doc-1647

23 Explain why a tree diagram is a useful way of displaying the results to a multi-stage experiment.

INVESTIGATE: Two-stage experiments

eBookplus
Digital doc
EXCEL Spreadsheet
doc-1644
Coin toss lister

1 Toss two coins 100 times. Copy and complete the table below.

Result	No. of times
2 Heads	
1 Head, 1 Tail	
2 Tails	

Does this match your expected outcome?

eBookplus
Digital doc
EXCEL Spreadsheet
doc-1646
Die rolling

2 Roll two dice 100 times and record the total of the two dice in a copy of the table below.

Total	2	3	4	5	6	7	8	9	10	11	12
No. of times											
Percentage											

Compare your results with your answer to question **19** in the previous exercise.

14D Equally likely outcomes

eBookplus
Interactivity
int–0089
Random number generator

Below is the field for the 2006 Melbourne Cup.

Melbourne Cup Odds			
Horse	**Odds**	**Horse**	**Odds**
Yeats	11-2	Zipping	9-1
Delta Blues	16-1	Dizelle	25-1
Railings	50-1	Ice Chariot	200-1
Tawqeet	5-1	Kerry O'Reilly	50-1
Geordieland	15-1	Zabeat	200-1
Headturner	66-1	Art Success	40-1
Short Pause	200-1	Demerger	100-1
Activation	20-1	Glistening	80-1
Land 'n' Stars	200-1	Mandela	20-1
Mahtoum	200-1	Dolphin Jo	80-1
On a Jeune	20-1	Maybe Better	9-1
Pop Rock	5-1	Efficient	SCR

There were 23 horses in this race after Efficient was scratched. The sample space therefore has 23 elements. However, in this case, each outcome is not equally likely. This is because each horse in the race is not of equal ability. Some horses have a greater chance of winning than others. It is true in many practical situations that each outcome is not equally likely to occur.

The weather on any day could be wet or fine. Each outcome is not equally likely as there are many factors to consider, such as the time of year and the current weather patterns.

In each probability example, it is important to consider whether or not each outcome is equally likely to occur. In general, when the selection is made randomly then **equally likely outcomes** will result.

WORKED EXAMPLE 12

In a rugby league match between Brisbane and Parramatta there are three possible outcomes: Brisbane win, Parramatta win and a draw. Is each outcome equally likely? Explain your answer.

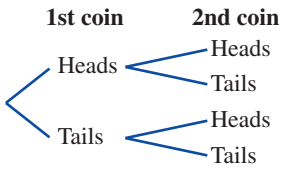
THINK	WRITE
Each team may not be of equal ability and draws occur less often than one of the teams winning.	Each outcome is not equally likely as the teams may not be of equal ability and draws are fairly uncommon in rugby league.

In some cases we need to use tree diagrams to calculate if each outcome is equally likely. A statement may seem logical, but unless further analysis is conducted, we can not be sure.

WORKED EXAMPLE 13

eBook*plus*
Tutorial
int–2342
Worked example 13

When two coins are tossed there are three possible outcomes, 2 Heads, 2 Tails and one of each. Is each outcome equally likely?

THINK	WRITE
1 There is more than one coin being tossed and so a tree diagram must be drawn.	
2 There are actually four outcomes, two of which involve 1 Head and 1 Tail. Therefore each of the outcomes mentioned is not equally likely to occur.	Each outcome is not equally likely. There are two chances of getting one Head and one Tail. There is only one chance of getting 2 Heads and one chance of getting 2 Tails.

REMEMBER

1. Each element of the sample space will not always be equally likely.
2. Outcomes will be equally likely if a selection is random. When other factors influence the selection, each outcome is not equally likely.
3. When there is more than one event involved, examine the tree diagram to determine if events described are equally likely.

EXERCISE
14D Equally likely outcomes

1 WE12 A tennis match is to be held between Lindsay and Anna. There are two possible outcomes, Lindsay to win and Anna to win. Is each outcome equally likely? Explain your answer.

2 There are 80 runners in the Olympic Games marathon. The sample space for the winner of the race therefore has 80 elements. Is each outcome equally likely? Explain your answer.

3 The numbers 1 to 40 are written on 40 marbles. The marbles are then placed in a bag and one is chosen from the bag. There are 40 elements to the sample space. Is each outcome equally likely? Explain your answer.

4 For each of the following, state whether each element of the sample space is equally likely to occur.

- **a** A card is chosen from a standard deck.
- **b** The result of a volleyball game between two teams.
- **c** It will either rain or be dry on a summer's day.
- **d** A raffle with 100 tickets has one ticket drawn to win first prize.

5 For each of the following, state whether the statement made is true or false. Give a reason for your answer.

- **a** Twenty-six cards each have one letter of the alphabet written on them. One card is then chosen at random. Each letter of the alphabet has an equal chance of being selected.
- **b** A book is opened on any page and a pin is stuck in the page. The letter closest to the pin is then noted. Each letter of the alphabet has an equal chance of being selected.

6 MC In which of the following is each member of the sample space equally likely to occur?

- **A** Kylie's softball team is playing a match that they could win, lose or draw.
- **B** A bag contains 4 red counters and 2 blue counters. One counter is selected from the bag.
- **C** The maximum temperature on a January day will be between 20°C and 42°C.
- **D** A rose that may bloom to be red, yellow or white is planted in the garden.

7 WE13 A couple have two children. They could have two boys, two girls or one of each. The sample space therefore has three elements that are all equally likely. Is this statement correct? Explain your answer.

8 In a game two dice are rolled and the total of the two dice is the player's score.

- **a** What is the sample space for the totals of two dice?
- **b** Is each element of the sample space equally likely to occur?

9 A restaurant offers a three-course meal. The menu is shown at right.

- **a** A diner selects one plate from each course. Draw a tree diagram to determine the number of elements in the sample space.
- **b** Is each element of the sample space equally likely to occur?

Entree	Main course	Dessert
Prawn cocktail Oysters Soup	Seafood platter Chicken Supreme Roast beef Vegetarian quiche	Pavlova Ice-cream

10 There are 10 horses in a race. Ken hopes to select the winner of the race.

- **a** How many elements in the sample space?
- **b** Is each element of the sample space equally likely to occur? Explain your answer.
- **c** Loretta selects her horse by drawing the names out of a hat. In this case, is the sample space the same? Is each element of the sample space equally likely to occur? Explain your answer.

Further development

11 The weather tomorrow could be either wet or dry.

- **a** Explain why these two outcomes are not equally likely.
- **b** What factors affect the probability of each?

12 In a tennis match, a player can either win or lose.
- **a** Explain why these two outcomes are not equally likely.
- **b** What factors affect the probability of each?

13 When rolling a standard die in a game, a player can get either a 6 or not get a 6.
- **a** Explain why these events are not equally likely.
- **b** Explain why we are able to calculate the probability of each.

14 When two children are born the outcomes can be two boys, two girls or one boy and one girl. Is each of these outcomes equally likely to occur? Explain your answer.

15 In a given situation, explain what some of the factors are that can indicate that each outcome is not equally likely.

16 When outcomes are not equally likely:
- **a** explain what we use in order to determine the likelihood of the event occurring
- **b** explain how we describe the likelihood of the event.

14E Using the fundamental counting principle

A three-course meal is to be served at a 21st birthday party. Guests choose one plate from each course, as shown in the menu below.

Entree	Main course	Dessert
Beef broth Calamari	Spaghetti Roast chicken Pasta salad Grilled fish	Ice-cream Banana split Strawberries

In how many different ways can the three courses for the meal be chosen?

There are two possible choices of entree, four choices for main course and three dessert choices. To find the sample space for all possible outcomes, we draw a tree diagram.

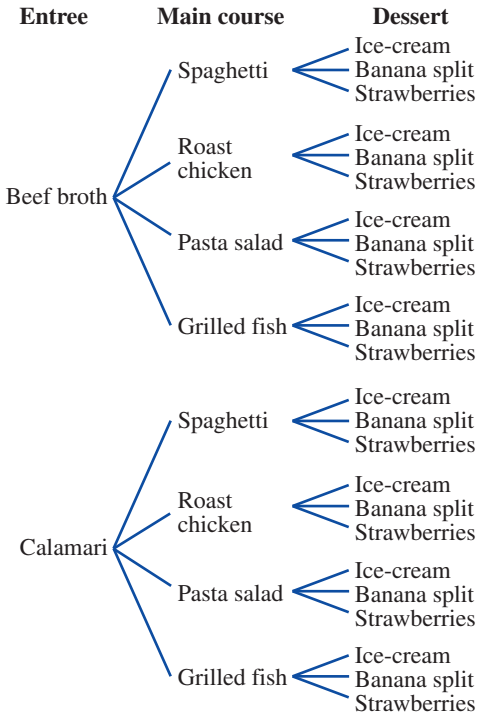
By following the path to the end of each branch we can see that there are 24 elements in the sample space. If we simply need to know the number of elements in the sample space, we multiply the number of possible choices at each level.

Number of elements $= 2 \times 4 \times 3$
$= 24$

There are 24 ways in which the three-course meal can be chosen.

This multiplication principle is called the **fundamental counting principle**.

The total number of ways that a succession of choices can be made is found by multiplying the number of ways each single choice could be made.



The fundamental counting principle is used when each choice is made independently of every other choice. That is, when one selection is made it has no bearing on the next selection. In the case above, the entree that is chosen has no bearing on what main course or dessert is chosen.

WORKED EXAMPLE 14

A poker machine has three wheels. There are 20 symbols on each wheel. In how many different ways can the wheels of the poker machine finish, once they have been spun?

THINK

1. There are 20 possibilities for how the first wheel can finish, 20 for the second wheel and 20 for the third wheel. Multiply each of these possibilities together.
2. Give a written answer.

WRITE

Total outcomes $= 20 \times 20 \times 20$
$= 8000$

There are 8000 different ways in which the wheels of the poker machine can land.

WORKED EXAMPLE 15

In Year 11 at Blackhurst High School, there are four classes with 20, 22, 18 and 25 students in them respectively. A committee of four people is to be chosen, one from each class to represent Year 11 on the SRC. In how many ways can this group of four people be chosen?

THINK	WRITE
1 There are 20 possible choices from the first class, 22 from the second, 18 from the third and 25 from the fourth class. Multiply these possibilities together.	Total possible outcomes = $20 \times 22 \times 18 \times 25$ $= 198\,000$
2 Give a written answer.	The committee of four people can be chosen in 198 000 different ways.

Sometimes we need to reconsider examples that have some type of restriction placed on the possible selections.

WORKED EXAMPLE 16

If motor vehicle number plates consist of 3 letters and 3 digits, how many different plates are possible if the first letter must be A, B or C, and the first digit cannot be 0 or 1?

eBook*plus*
Tutorial int–2343 **Worked example 16**

THINK	WRITE
1 There are 3 possible first letters.	
2 There are 26 possible second and third letters.	
3 There are 8 possible first digits.	
4 There are 10 possible second and third digits.	
5 Multiply all these possibilities together.	Total number plates = $3 \times 26 \times 26 \times 8 \times 10 \times 10$ $= 1\,622\,400$
6 Give a written answer.	There are 1 622 400 possible number plates under this system.

REMEMBER

1. The fundamental counting technique allows us to calculate the number of different ways that separate events can occur.
2. This method can be used only when each selection is made independently of the others. To use this method, we multiply the number of ways that each selection can be made.

EXERCISE

14E Using the fundamental counting principle

1 WE14 A poker machine has four reels, with 15 symbols on each wheel. If the wheels are spun, in how many ways can they finish?

2 Consider each of the following events.
- **a** A 10c coin and a 20c coin are tossed. In how many ways can they land?
- **b** A red die and blue die are cast. How many ways can the two dice land?
- **c** A coin is tossed and a die is rolled. How many possible outcomes are there?

3 A briefcase combination lock has a combination of three dials, each with 10 digits. How many possible combinations to the lock are there?

4 In the game of Yatzee, five dice are rolled. In how many different ways can they land?

5 Some number plates have two letters followed by 4 numbers. How many of this style of plate are possible?

6 MC Personalised number plates have six symbols that can be any combination of letters or digits. How many of these are possible?

A 1 000 000 **B** 17 576 000 **C** 308 915 776 **D** 2 176 782 336

7 MC A restaurant menu offers a choice of four entrees, six main courses and three desserts. If one extra choice is offered in each of the three courses, how many more combinations of meal are possible?

A 3 **B** 68 **C** 72 **D** 140

8 WE15 There are 86 students in Year 11 at Narratime High School. Of these, 47 are boys and 39 are girls. One boy and one girl are to be chosen as school captains. In how many different ways can the boy and girl school captain be chosen?

9 A travel agency offers Queensland holiday packages flying with QANTAS and Virgin Blue, travelling in First, Business and Economy class to Brisbane, the Gold Coast, The Great Barrier Reef and Cairns for periods of 7, 10 and 14 days. How many holiday packages does the traveller have to choose from?

10 A punter at the racetrack tries to pick the daily double. This requires her to pick the winner of race 6 and race 7. How many selections of two horses can she make if there are:
- **a** eight horses in each race?
- **b** 12 horses in each race?
- **c** 14 horses in race 6 and 12 in race 7?
- **d** 16 horses in race 6 and seven in race 7?
- **e** 24 horses in race 6 and 16 horses in race 7?

11 A poker machine has five wheels and 20 symbols on each wheel.
- **a** In how many ways can the wheels of the poker machine finish when spun?
- **b** There are 4 aces on the first wheel, 5 on the second wheel, 2 on the third wheel, 6 on the fourth wheel and 1 on the fifth. In how many ways can five aces be spun on this machine?

12 A punter takes a 'Big 6' which requires her to select the winner of six races. How many ways can the Big 6 be selected if there are 15, 12, 7, 8, 18 and 14 runners in the six races?

13 Rhonda takes a mystery holiday. She can go to one of five destinations, fly on one of three airlines and stay at one of six different hotel chains. How many different mystery holidays are possible?

14 A theme park advertises that every time you ride the *Hurricane*, the ride will be different. When the ride begins it can go through two different tunnels after which, they merge before it can go through one of three different tunnels before merging again, and then go though one of two different tunnels.
- **a** How many different rides are possible?
- **b** Is the claim made by the theme park operators correct?

15 Radio stations on the AM band have a call sign of a digit from 2 to 9, followed by two letters.
- **a** How many radio stations could there be under this system?
- **b** In NSW all stations begin with a 2. How many stations are possible in NSW?

16 At a shoe store a certain pair of shoes can be bought in black, brown or grey; lace up or buckle up; and in six different sizes. How many different pairs of shoes are possible?

17 Home telephone numbers in Australia have eight digits.
- **a** How many possible home telephone numbers are there?
- **b** If a telephone number can't begin with either a 0 or 1, how many are possible?
- **c** Freecall 1800 numbers begin with 1800 and then six more digits. How many of these are possible?
- **d** A certain mobile network has numbers beginning with 015 or 018 followed by six digits. How many numbers can this network have?

18 WE16 Madako can't remember his PIN number for his bank account. He knows that it has four digits, does not begin with nine, is an odd number and that all digits are greater than five. How many possible PIN numbers could he try?

19 MC Postcodes in Australia begin with either 2, 3, 4, 5, 6, 7 or 8 followed by three more digits. How many of these postcodes can there be?

A 70 **B** 1000 **C** 7000 **D** 10 000

Further development

20 Nadia goes to a restaurant that has a choice of 8 entrees, 15 main courses and 10 desserts.
- **a** How many combinations of entree, main course and dessert are possible?
- **b** Nadia is allergic to garlic. When she examines the menu she finds that three entrees and four main courses are seasoned with garlic. How many possible choices can she make without choosing a garlic dish?

21 Bill is trying to remember Tom's telephone number. It has eight digits and Bill can remember that it starts with 963 and finishes with either a 4 or a 6. How many possible telephone numbers are there for Tom?

22 A representative from each of six classes must be chosen to go on a committee. There are four classes of 28 students, a class of 25 students and a class of 20 students. How many committees are possible?

23 A poker machine with 5 reels has 10 electronic symbols on each reel.
- **a** How many combinations are possible on the poker machine?
- **b** New software increases the number of symbols on each reel by 20%. How many symbols will now be on each reel?
- **c** Connie claims that the number of combinations on the poker machine will increase by 20%. Is Connie correct? Use calculations to justify your answer.

24 A poker machine with 5 reels has 20 symbols on each reel. The machine has the number of symbols on each reel reduced by 25%. By what percentage is the total number of combinations reduced?

25 What is the fundamental counting principle?

eBook*plus*
Digital doc
WorkSHEET 14.2
doc-1650

SUMMARY

Informal description of chance

- The chance of an event occurring can be described as being from certain (a probability of 1) to impossible (a probability of 0).
- Terms used to describe the chance of an event occurring include improbable, unlikely, fifty-fifty, likely and probable.
- The chance of an event occurring can be described by counting the possible outcomes and sometimes by relying on our general knowledge.

Sample space

- A sample space is a list of all possible outcomes to a probability experiment.
- It includes every possible outcome even if some outcomes are the same.

Tree diagrams

- Tree diagrams are used to list the sample space when there is more than one stage to a probability experiment.
- The tree must branch out once for each stage of the probability experiment.

Equally likely outcomes

- Equally likely events occur when the selection method is random.
- Events will not be equally likely when other factors influence selection. For example, in a race each person will not have an equal chance of winning, as each runner will be of different ability.

Using the fundamental counting principle

- This principle can be used to count the number of elements in a sample space of a multi-stage experiment.
- The total number of possible outcomes is calculated by multiplying the number of ways each stage of the experiment can occur.

CHAPTER REVIEW

MULTIPLE CHOICE

1 MC Jason and Kylie are playing a game of Monopoly. To move your piece, you roll two dice and move the same number of places as the total of the two dice. Kylie needs a total of 7 to land on Mayfair. The chance of Kylie rolling a 7 could best be described as:
- **A** impossible
- **B** unlikely
- **C** fifty-fifty
- **D** probable

2 MC To win a game, Rhonda must roll a number greater than 3 with a single die. Which of the following statements is correct?
- **A** The sample space has 3 elements and there are 3 favourable outcomes.
- **B** The sample space has 3 elements and there are 6 favourable outcomes.
- **C** The sample space has 6 elements and there are 3 favourable outcomes.
- **D** The sample space has 6 elements and there are 6 favourable outcomes.

3 MC A three-digit number is to be formed using the digits 3, 6, 7 and 8. The same number cannot be used more than once. How many three-digit numbers can be formed?
- **A** 4
- **B** 12
- **C** 24
- **D** 64

4 MC For which of the following events is each element of the sample space equally likely to occur?
- **A** The likelihood of selecting the winning Lotto combination
- **B** The likelihood of the weather being wet or fine
- **C** The likelihood of passing your next Maths exam
- **D** The likelihood of being successful in a job interview

5 MC One person from each Year 11 class is to be elected to the Student Representative Council. If there are four classes in Year 11 with 23, 20, 19 and 25 people in these classes, the number of possible combinations of four representatives is:
- **A** 87
- **B** 348
- **C** 218 500
- **D** 874 000

SHORT ANSWER

1 Graham and Marcia are playing a game. To see who starts they each take a card from a standard deck. The player with the higher card starts. Graham takes a five. Describe Marcia's chance of taking a higher card.

2 Describe each of the following events as being either certain, probable, even chance (fifty-fifty), unlikely or impossible.
- **a** Rolling a die and getting a number less than 6
- **b** Choosing the eleven of diamonds from a standard deck of cards
- **c** Tossing a coin and it landing Tails
- **d** Rolling two dice and getting a total of 12
- **e** Winning the lottery with one ticket

3 Give an example of an event which is:
- **a** certain
- **b** impossible.

4 The Chen family are going on holidays to Queensland during January. Are they more likely to experience hot weather or cold weather?

5 List each of the events below in order from most likely to least likely.

Winning a lottery with 1 ticket out of 100 000 tickets sold

Rolling a die and getting a number greater than 1

Selecting a blue marble out of a bag containing 14 blue, 15 red and 21 green marbles

Selecting a picture card from a standard deck

6 Mark and Lleyton are tennis players who have played eight previous matches. Mark has won six of these matches. When they play their ninth match, who is more likely to win? Explain your answer.

7 The letters of the word SAMPLE are written on cards and placed face down. One card is then selected at random. List the sample space.

8 List the sample space for each of the following probability experiments.
- **a** A coin is tossed.
- **b** A number is selected from the numbers 1 to 18.
- **c** The four aces from a deck of cards are selected. One of these cards is then chosen.
- **d** A bag contains 4 black marbles, 3 white marbles and 5 green marbles. One marble is then selected from the bag.

9 To win a game, Sarah must roll a number greater than 4 on the die.
- **a** List the sample space.
- **b** List the favourable outcomes.

10 For each of the following, state:
- **i** the number of elements in the sample space
- **ii** the number of favourable outcomes.

- **a** At the start of a cricket match, a coin is tossed and Steve calls Heads.
- **b** Anne selects a card from a standard deck and needs a number less than 9. (Aces count as 1.)
- **c** A bag contains 3 red, 8 blue and 4 black discs. Florian draws a disc from the bag and must not draw a black disc.

11 Two coins are tossed. Draw a tree diagram to find the sample space.

12 Two dice are rolled. How many elements are in the sample space?

13 A two-digit number is formed using 5, 6, 7 and 9, without repetition.
- **a** Use a tree diagram to list the sample space.
- **b** If Dan wants to make a number greater than 60, how many favourable outcomes are there?

14 Mary, Neville, Paul, Rachel and Simon are candidates for an election. There are two positions, president and vice-president. One person cannot hold both positions.
- **a** List the sample space.
- **b** If Paul is to hold one of the positions, how many elements are in the event space?

15 A school must elect one representative from each of three classes to sit on a committee. In 11A the candidates are Tran and Karen. In 11B the candidates are Cara, Daisy, Henry and Ian. In 11C the candidates are Bojan, Melina and Zelko.
- **a** List the sample space.
- **b** If there is to be at least one boy and at least one girl on the committee, how many elements are in the sample space?

16 A greyhound race has eight runners.
- **a** How many elements are in the sample space?
- **b** Is each element of the sample space equally likely to occur? Explain your answer.

17 For each of the following, explain if each element of the sample space is equally likely to occur.
- **a** There are 150 000 tickets in a lottery. One ticket is drawn to win first prize.
- **b** There are twelve teams contesting a hockey tournament. One team is to win the tournament.
- **c** A letter is chosen from the page of a book.

18 A poker machine has five wheels. Each wheel has 15 symbols on it. In how many ways can the wheels land?

19 There are four roads that lead from town A to town B, and five roads that lead from town B to town C. In how many different ways can I travel from town A to town C?

20 The daily double requires a punter to select the winner of two races. How many selections are possible if there are 16 horses in the first leg and 17 in the second leg?

21 At a restaurant, a patron has the choice of five entrees, eight main courses and four desserts. In how many ways can they choose their meal?

22 Jake has a bike chain that has a dial with four wheels, with 10 digits on each wheel.
- **a** How many different combinations are possible?
- **b** Jake has forgotten his combination. He can remember that the first digit is 5, and the last digit is odd. How many different combinations could there be to his chain?

23 The dial to a safe consists of 100 numbers. To open the safe, you must turn the dial to each of four numbers that form the safe's combination.
- **a** How many different combinations to the safe are possible?
- **b** How many different combinations are possible if no number can be used twice?

EXTENDED RESPONSE

1 At a school athletics carnival, a relay team must be selected. Below is the list of students who qualified and the house for which they compete. There must be one member of the relay team from each house.

RED	YELLOW	BLUE	GREEN
Richard Stan	Andrew Frank Ned Voula	Boris Harry Danny	Milan

a Draw a tree diagram to show all possible relay teams.
b How many elements are in the sample space?
c If Ned is to be in the relay team, how many favourable outcomes are there?
d Describe the chance of Milan being in the relay team.
e Is each element of the sample space equally likely to occur? Explain your answer.

2 Gino, Dennis, Kurt and Colin make up a tennis team. Two of them are to represent the club at a tournament.
a Draw a tree diagram, to find the sample space for all possible teams.
b List the favourable outcomes if Colin is to be in the team.
c If the two selected players are to play two players selected from a group of six from another club, in how many ways can the final four players be chosen?

eBookplus ACTIVITIES

Are you ready?

Digital docs *(page 452)*
- SkillSHEET 14.1 (doc-1639): Understanding chance words
- SkillSHEET 14.2 (doc-1640): Understanding a deck of cards
- SkillSHEET 14.3 (doc-1641): Probability scale I
- SkillSHEET 14.4 (doc-1642): Probability scale II
- SkillSHEET 14.5 (doc-1643): Listing the sample space

14A Informal description of chance

Digital docs
- SkillSHEET 14.1 (doc-1639): Understanding chance words *(page 455)*
- SkillSHEET 14.2 (doc-1640): Understanding a deck of cards *(page 455)*
- SkillSHEET 14.3 (doc-1641): Probability scale I *(page 455)*
- SkillSHEET 14.4 (doc-1642): Probability scale II *(page 456)*

14B Sample space

Digital docs
- SkillSHEET 14.5 (doc-1643): Listing the sample space *(page 459)*
- Spreadsheet (doc-1644): Coin toss lister *(page 461)*
- Spreadsheet (doc-1645): Dice *(page 461)*
- Spreadsheet (doc-1646): Die rolling *(page 461)*

14C Tree diagrams

Tutorial
- WE11 int-2341: Learn to construct a tree diagram and sample space. *(page 462)*

Digital docs
- WorkSHEET 14.1 (doc-1647): Apply your knowledge of chance to problems. *(page 465)*
- Spreadsheet (doc-1644): Coin toss lister *(page 465)*
- Spreadsheet (doc-1646): Die rolling *(page 465)*

14D Equally likely outcomes

Interactivity
- int-0089: Random number generator *(page 466)*

Tutorial
- WE13 int-2342: Learn to construct a tree diagram to determine if events are equally likely. *(page 467)*

14E Using the fundamental counting principle

Tutorial
- WE16 int-2343: Learn to apply your knowledge of probability and the counting principle to car number plates. *(page 471)*

Digital docs
- WorkSHEET 14.2 (doc-1650): Apply your knowledge of probability and the fundamental counting principle to a range of questions. *(page 473)*

Chapter review

- Test yourself Chapter 14 (doc-1651): Take the end-of-chapter test to test your progress. *(page 477)*

To access eBookPLUS activities, log on to

www.jacplus.com.au